

Only the longest "fundamental" line was absorbed.

The line was thicker than the D line in the solar spectrum, in which spectrum all the short lines are reversed.

2. As it was difficult largely to increase either the temperature or the density of the sodium-vapour, I have made another series of experiments with iodine-vapour.

I have already pointed out the differences indicated by the spectro-scope between the quality of the vibrations of the "atom" of a metal and of the "subatom" of a metalloid (by which term I define that mass of matter which gives us a spectrum of channelled spaces, and builds up the continuous spectrum in its own way). Thus, in iodine, the short lines, brought about by increase of density in an atomic spectrum, are represented by the addition of a system of well-defined "beats" and broad bands of continuous absorption to the simplest spectrum, which is one exquisitely rhythmical, the intervals increasing from the blue to the red, and in which the beats are scarcely noticeable.

On increasing the density of a very small thickness by a gentle heating, the beats and bands are introduced, and, as the density is still further increased, the absorption becomes continuous throughout the whole of the visible spectrum.

The absorption of a thickness of 5 feet 6 inches of iodine-vapour at a temperature of 59° F. has given me no indication of bands, while the beats were so faint that they were scarcely visible.

VI. "Spectroscopic Notes.—No. II. On the Evidence of Variation in Molecular Structure." By J. NORMAN LOCKYER, F.R.S. Received May 26, 1874.

1. In an accompanying note I have shown that when different degrees of dissociating power are employed the spectral effects are different.

2. In the present note I propose to give a preliminary account of some researches which have led me to the conclusion that, starting with a mass of elemental matter, such mass of matter is continually broken up as the temperature (including in this term the action of electricity) is raised.

3. The evidence upon which I rely is furnished by the spectroscope in the region of the visible spectrum.

4. To begin by the extreme cases, all solids give us continuous spectra; all vapours produced by the high-tension spark give us line-spectra.

5. Now the continuous spectrum may be, and as a matter of fact is, observed in the case of chemical compounds, whereas all compounds known as such are resolved by the high-tension spark into their constituent elements. We have a right, therefore, to assume that an element in the solid state is a more complex mass than the element in a state of vapour, as its spectrum is the same as that of a mass which is known to be more complex.

6. The spectroscope supplies us with intermediate stages between these extremes.

(α) The spectra vary as we pass from the induced current with the jar to the spark without the jar, to the voltaic arc, or to the highest temperature produced by combustion. The change is always in the same direction; and here, again, the spectrum we obtain from elements in a state of vapour (a spectrum characterized by spaces and bands) is similar to that we obtain from vapours of which the compound nature is unquestioned.

(β) At high temperatures, produced by combustion, the vapours of some elements (which give us neither line- nor channelled space-spectra at those temperatures, although we undoubtedly get line-spectra when electricity is employed, as stated in 4) give us a continuous spectrum at the more refrangible end, the less refrangible end being unaffected.

(γ) At ordinary temperatures, in some cases, as in selenium, the more refrangible end is absorbed; in others the continuous spectrum in the blue is accompanied by a continuous spectrum in the red. On the application of heat, the spectrum in the red disappears, that in the blue remains; and further, as Faraday has shown in his researches on gold-leaf, the masses which absorb in the blue may be isolated from those which absorb in the red. It is well known that many substances known to be compounds in solution give us absorption in the blue or blue and red; and, also, that the addition of a substance known to be compound (such as water) to substances known to be compound which absorb the blue, superadds an absorption in the red.

7. In those cases which do not conform to what has been stated the limited range of the visible spectrum must be borne in mind. Thus I have little doubt that the simple gases, at the ordinary conditions of temperature and pressure, have an absorption in the ultra-violet, and that highly compound vapours are often colourless because their absorption is beyond the red, with or without an absorption in the ultra-violet. Glass is a good case in point; others will certainly suggest themselves as opposed to the opacity of the metals.

8. If we assume, in accordance with what has been stated, that the various spectra to which I have referred are really due to different molecular aggregations, we shall have the following series, going from the more simple to the more complex:—

First stage of complexity of molecule	} Line-spectrum.
Second stage	
Third stage	{ Continuous absorption at the blue end not reaching to the less refran- gible end. (This absorption may break up into channelled spaces.)

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|------------------------|---|---|
| Fourth stage | { | Continuous absorption at the red end not reaching to the more refrangible end. (This absorption may break up into channelled spaces.) |
| Fifth stage | | Unique continuous absorption. |

9. I shall content myself in the present note by giving one or two instances of the passage of spectra from one stage to another, beginning at the fifth stage.

From 5 to 4.

1. The absorption of the vapours of K in the red-hot tube, described in another note, is at first continuous. As the action of the heat is continued, this continuous spectrum breaks in the middle; one part of it retreats to the blue, the other to the red.

From 4 to 3.

1. Faraday's researches on gold-leaf best illustrate this; but I hold that my explanation of them by masses of two degrees of complexity only is sufficient without his conclusion ('Researches in Chemistry,' p. 417), that they exist "of intermediate sizes or proportions."

From 3 to 2.

1. Sulphur-vapour first gives a continuous spectrum at the blue end; on heating, this breaks up into a channelled space-spectrum.

2. The new spectra of K and Na (more particularly referred to in the third note) make their appearance after the continuous absorption in the blue and red vanishes.

From 2 to 1.

1. In many metalloids the spectra, without the jar, are channelled; on throwing the jar into the circuit the line-spectrum is produced, while the cooler exterior vapour gives a channelled absorption-spectrum.

2. The new spectra of K and Na change into the line-spectrum (with thick lines which thin subsequently) as the heat is continued.

VII. "Spectroscopic Notes.—No. III. On the Molecular Structure of Vapours in connexion with their Densities." By J. NORMAN LOCKYER, F.R.S. Received May 26, 1874.

1. I have recently attempted to bring the spectroscope to bear upon the question whether vapours of elements below the highest temperatures are truly homogeneous, and whether the vapours of different chemical elements, at any one temperature, are all in a similar molecular condition. In the present note, I beg to lay before the Royal Society the preliminary results of my researches.